Bay Area Air Quality Management District

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Proposed Amendments to BAAQMD Regulation 8 (Organic Compounds) Rule 18 (Equipment Leaks)

Draft Staff Report

October 2003

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I. EXECUTIVE SUMMARY

This rulemaking process is intended to implement Control Measure SS-16 (Low-Emission Refinery Valves) from the Bay Area 2001 Ozone Attainment Plan and to clarify specific provisions of the rule to ensure consistency. The Bay Area Air Quality Management District reviewed specific valve technologies to determine short-term and long-term emission performance so that Regulation 8, Rule 18, Equipment Leaks (Reg 8-18), could limit equipment replacements to these technologies.

District staff examined various other aspects of Reg 8-18 to determine whether emission reductions are available from other potential amendments to the rule.

II. BACKGROUND

There are five petroleum refineries within the jurisdiction of the District. Each of these refineries has at least 20,000 valves and a larger population of connections. Rule amendments adopted in 1992 significantly lowered the allowable leak concentration limits to the lowest in the country and required more effective inspection and repair programs in order to reduce emissions and avoid non-compliance. The 1992 amendments reduced emissions by 1.2 tons per day.

The current regulatory effort centers around four key concepts:

- Employ the best available control technologies (BACT) to reduce emissions when replacing leaking components;
- Reduce the fraction of components that are allowed on the non-repairable list;
- Set an upper limit of 10,000 ppm for any leaking component; and
- Allow connections to be placed on the non-repairable list at a ratio of one connection per two valves.

BACT

Control Measure SS-16 proposed that when valves subject to Reg 8-18 are replaced, BACT is used to minimize fugitive emissions. Individual valves are not required to have a permit under District Regulation 2, Rule 1, however, fugitive emissions are permitted. Therefore, replacement valves may not be subjected to New Source Review (Regulation 2, Rule 2) and the requirement for the use of BACT.

The current rule imposes the most stringent fugitive emission requirements in the nation – a 100 ppm standard. Owners and operators are cognizant of this fact and are likely to install replacement valves that offer better performance to achieve the standard. After reviewing specific valve technologies that offer improved short-term and long-term emissions performance, the District

determined the100 ppm standard results in the industry choosing the best technology to meet the standard.

Non-Repairable List

The District will reduce the fraction of valves that can be on a non-repairable to reflect the status quo at the refineries. Although the rule currently allows up to 0.5 percent of the valves to be placed on the non-repairable list, a review of the historical data indicates that this fraction can be reduced significantly. Most refineries operate within the range of 0.1 to 0.3 percent of valves placed on the non-repairable list. The rule currently allows up to 0.5 percent of the valve to leak at any concentration for as long as five years. The proposed rule reduces the limit to 0.3 percent and provides approximately 350 pounds per day of emission reductions below the amount currently allowed.

Limit Leaking Components to 10,000 ppm

The proposed rule will not allow components leaking above 10,000 ppm to be placed on the non-repairable list unless the mass emission rate is measured and determined to be less than 1.0 pounds per day. Revised correlation factors published in the Air Resources Board's "California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities" indicate that although a small fraction of components leak in excess of 10,000 ppm, that fraction is responsible for the vast majority of emissions. This approach will require facilities to control the greatest emitters by repairing or replacing those components or by abating those emissions to a control device. This provision is responsible for the largest amount of emission reductions.

Allowance of Connections on the Non-Repairable List

Refineries have requested that connections be allowed to be placed on the non-repairable list because there are occasions when the repair of a connection could cause a shutdown of a plant, which could potentially result in large emissions. To address this request, staff proposes to allow connections to be placed on the non-repairable list in a very limited fashion. Connections would be allowed on the non-repairable list only as replacements to valves that would have been allowed on the list and at a ratio of one connection per two valves. This would provide the relief requested by the refineries without relaxing the stringency of the rule.

Additional Areas for Emissions Reductions

In addition, there remain several areas where additional emission reductions may be realized. District staff intends to examine other potential emission reduction strategies related to equipment leaks at refineries. As a result, other amendments may be proposed to achieve additional reductions or to clarify existing rule provisions. Some of these additional areas include:

- Modification of the District's BACT determination for other equipment;
- Utilization of alternative pump and compressor technologies that could potentially reduce fugitive emissions;
- Revisions to the manner in which equipment is added to and removed from the non-repairable list;
- More stringent compliance actions during District inspections;
- Replacement of irreparable equipment with BACT;
- Accelerated replacement of equipment that have a history of elevated leak occurrences with technologies identified as BACT during this rule making process;
- Replacement of inaccessible equipment with superior technologies;
- Enclosing and venting seals to a control device;
- Additional regulatory requirements on heat exchangers such as more frequent inspections and identifying leaks into cooling water that are emitted via the cooling towers that presently are undetected.
- Modification of inspection frequencies; and
- Utilization of the "Smart" leak detection and repair (LDAR) programs.

Summary of Rule 8-18, Equipment Leaks

Each of the five refineries within the District has in place an LDAR program. These programs function to ensure that all components are inspected regularly and, if a leak is found, the equipment is repaired, replaced, or placed on a non-repairable list. Under the current rule, there are four options under which a facility may comply with the rule:

Option 1 – Leak Concentration Standard: This option allows the facility to inspect affected equipment for leaks; 100 ppm for valves and connections, and 500 ppm for pumps, compressors and pressure relief devices. All equipment with leaks discovered by the facility must be minimized within 24 hours and repaired within seven days. All leaks discovered by the District must be repaired within 24 hours. All equipment not subject to an LDAR program discovered to be leaking by the District is a violation of this rule.

A fraction of the equipment that cannot be repaired may be placed on a non-repairable list for up to five years or the next scheduled turnaround for that plant, whichever date comes first. The maximum fraction of components on the facility-wide turnaround list cannot exceed 0.5 percent for valves and 1.0 percent for pumps, compressors and pressure relief devices. Connections are not allowed to be placed on a turnaround list.

Option 2 – Mass Emissions Standard: This option allows the facility to use the concentration standards as trigger levels and measure any non-repairable component for mass emissions. Using the above Option 1 leak concentration standards as trigger levels, any non-repairable component can be measured for mass emissions. If the mass emission rate is greater than 15 lbs/day, the component must be repaired. If the mass emission rate is less than 0.1 or 0.2 lb/day, no further action is required. The number of components leaking between 0.1 or 0.2 and 15 lbs/day cannot exceed a small percentage of the total number of components at the facility.

Option 3 – Reduced Inspection Frequency: Using the above Option 1 leak concentration standards as trigger levels, facilities can increase the interval between inspections for components that do not leak. This option will reduce the cost of inspection and maintenance plans. The inspection frequency for equipment, except pumps and compressors, may be changed from quarterly to annually provided the equipment has been operated leak free for five consecutive quarters and records are submitted and approved by the District. If a leak is discovered, the frequency reverts back to quarterly inspections for that component.

Option 4 – District Approved Inspection and Maintenance Plan: The final option allows facilities to implement an alternate program to reduce emissions from leaks. This option requires a written plan approved by the District and EPA. To date, no Bay Area refinery has elected to use this option.

Other Air District Rules

Several other air pollution control districts in California have rules that address fugitive emissions from refineries and chemical plants. These districts include the South Coast Air Quality Management District (Rule 1173), the San Joaquin Valley Unified Air Pollution Control District (4451 & 4452), and Ventura County Air Pollution Control District (Rule 74.7). In addition to these districts' rules, the federal New Source Performance Standards[1] affect emissions from equipment leaks. The table in Appendix A provides a simplified comparison of the major provisions of these rules with the provisions of the District's current rule.

Overview of Current Leak Detection and Repair (LDAR) Programs

Each LDAR program functions to ensure that all components are:

- Identified
- Labeled (except connections)
- Inventoried
- Inspected for leaks
- If found leaking, tagged, repaired, replaced, or placed on a turnaround list.

Identification: Each piece of equipment is uniquely identified in association with the plant at which it is located, the type of equipment, and a unique identification number.

Labels: In addition, this identity is also placed on a label that is attached to each component or group of components. Labels contain varying degrees of information, but most will at least include the identification number.

Inventory: Each piece of equipment is inventoried in a database that contains information on the equipment such as type, location, installation date, dates of inspection, leak concentration, and repair history.

Inspections: Each refinery employs an inspection team that consists of either in-house employees or contractors[2]. The inspection team calibrates their VOC detector, which is typically either a flame or photo ionization detector, and proceeds with the inspection. A member of the inspection team carries a monitoring device that reads and records information from a barcode or identifier attached to the component being inspected. If a leak is detected, a team member or another facility employee will attempt to minimize the leak. If the leak

[2] Three of the five Bay Area refineries employ independent contractors to conduct leak detection and repair, and the remaining refineries utilize in-house employees. All refineries have a separate group dedicated to the task of leak detection and repair.

cannot be minimized, a team member will identify the component with a waterproof, indelible tag, upon which information regarding the leak is recorded and the component is identified for repair or replacement. Once the inspection is completed, the recorded information is uploaded into an LDAR data base.

BACT Determinations

The District reviewed equipment that could represent Best Available Control Technology for valves, pumps, compressors, pressure relief devices and for previously unspecified equipment, such as heat exchangers.

Valves

There are several valve types on the market and in use that have been demonstrated in practice to operate in a "leak free" manner. These valves include bellows seal valves and solenoid-actuated valves, which are both hermetically sealed to reduce the potential for fugitive emissions. Hermetically seal means that the valve is air tight.

Bellows Seal Valves

Bellows seal valves normally operate in a leak free manner because the moving components of the valve are hermetically sealed from the ambient air. Bellows seal valves function by replacing the packing and sliding or rotating seals with bellows (accordion-like tubing). This replacement eliminates the opportunity for emissions from the sliding or rotating seals/packing. (However, without monitoring, failure of the bellows can result in emissions).

The bellows are sealed in two different ways. In one manner the bellows are welded to the valve stem at the top and the valve body at the bottom. The process fluid is contained inside the bellows. In the other method, the bellows are welded to the valve stem at the bottom and the body on the top. The process fluid is contained in the annular region between the valve bonnet and bellows.

Solenoid-Actuated Valves

Solenoid-actuated valves are a departure from the standard air- or motor-operated valve design typically used for process fluid storage and handling of hydrocarbons. These valves are solenoid-actuated. They do not use stem, packing, or bellows. Further, solenoid-actuated valves isolate all moving parts within the process pressure areas. Because the actuator of these valves is completely sealed from the atmosphere and is actuated via magnetism, the potential for emissions due to the failure of seals surrounding dynamically moving parts is eliminated.

Pumps/Compressors

Recent development in pump technologies may offer some potential for emission reductions. Hermetically sealed pumps have been available on the market and in use for decades. There are two basic categories of pumps, canned induction motor driven pumps and the synchronous and asynchronous magnetic driven pumps. Because these pumps are hermetically sealed, the potential for fugitive emissions is greatly reduced from pumps using seals. Currently, the number of sealed pumps in operation at the five Bay Area refineries is unknown. If further evaluation and analyses indicate that sealed pumps can function as well as hermetically sealed pumps, then a BACT determination could reflect this performance and the Districts regulatory approach could take advantage of their use in refineries.

III. PRIMARY RULE ADMENDMENTS

A number of regulatory issues regarding the existing rule have been raised. Developing these issues through the rule making process into regulation amendments could contribute towards emissions reductions. Provisions for examining this rule were made under Control Measure SS-16 low emission refinery valves in the October 2001 Bay Area Ozone Attainment Plan.

Replacement of Non-Repairable Equipment with BACT

Leaking critical service equipment that cannot be repaired must be replaced with equipment that can meet the leak standard of the rule. This equipment must be replaced within five years or the next process shutdown, whichever occurs first. Currently, the South Coast AQMD and Ventura County Air Pollution Control District have such provisions in their fugitive emissions rules.[3] Staff will continue to evaluate newer technologies, such as bellows seal, solenoid-activated valves and hermetically sealed pumps and compressors, to determine how effective these devices are in reducing fugitive emissions.

Number of Components on the Non-Repairable List

The non-repairable list was established to provide a mechanism to address essential components. Essential components are those pieces of equipment that cannot be repaired or replaced unless the process unit is shutdown and the component is isolated. This activity would likely create more emissions than the actual fugitive leak. The rule allows a certain percentage of each type of equipment to be placed on the list. Table 1 indicates the current allowable fractions of each component on the non-repairable list.

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[3] South Coast AQMD Rule 1173, §(g)(2) and Ventura County APCD Rule 74-7, §§E.5 and E.7.

Table 1
Current Allowable Limits for Components Awaiting Repair or Replacement

Equipment	Fraction of Non-repairable Equipment Allowable	Maximum Duration
Valves	0.5%	5 years or next turnaround
Pressure Relief Devices	1 %	5 years or next turnaround
Pumps/Compressors	1 %	5 years or next turnaround

Preliminary data indicate that the present LDAR programs implemented at some refineries result in a much lower fraction of leaking equipment placed on a non-repairable list than the fraction allowable by the Reg 8-18. This suggests that it is possible to reduce the percentage of equipment allowed on the non-repairable list or address non-repairable equipment in a different manner.

Staff proposes to modify the allowable fractions and durations according to the table below.

Table 2
Proposed Revisions to the Allowable Limits for Components Awaiting Repair or Replacement

Equipment	Fraction of Non-repairable Equipment Allowable up to 10,000 ppm	Maximum Duration
Valves	0.2%	5 years or next shutdown
Pressure Relief Devices	1 %	5 years or next turnaround
Pumps/Compressors	1 %	5 years or next shutdown

Concentration Limit for Non-repairable Components

The proposed amendments also include a maximum concentration limit at which a component can leak. It appears unreasonable to allow a component to leak an indefinite amount of mass emissions for up to five years.

The amendments will require refineries to take action on components that are found leaking in excess of 10,000 ppm (50 to 100 times the allowable limits). If a component is found to leak in excess of 10,000 ppm, the operator must do one of the following; 1) minimized the leak below 10,000 ppm within 24 hours and repair the component within seven days, or 2) measure the mass emission rate of the leak and place the component on the non-repairable list only if the mass emission rate is less than 1.0 lbs per day for valves, pumps and compressors. If the component leaks in excess of the mass emission rate limits, then the

operator must either repair or replace that component or capture and vent those emissions to a control device.

This provision will provide an incentive for refineries to address the most severe leaking components first, before considering placing that component on the non-repairable list. The inability to repair a component does not necessarily result in the shutdown of a plant. The rule allows the emissions to be routed to an air pollution control device in the interim between shutdowns or turnarounds. Several other air districts in California that have refineries within their jurisdictions employ similar approaches in their fugitive emissions rules.[4] An initial assessment of data reported by the refineries indicate that less than one in 5000 components leak in excess of 10,000 ppm, which is less than ten at any one refinery. Only a fraction of these components are expected to have mass emissions rates in excess of the preset limits. Those that exceed the limits would have to be addressed.

Connections on the Non-repairable List

The refineries have long asserted that regulatory relief is needed for connections that pose difficulty in repair. To address this concern, staff proposes allowing connections to be placed on the non-repairable list in a very limited fashion that would not result in a relaxation of the rule. To ensure that any emissions associated with a connection being placed on the non-repairable list is offset, the rule will contain a disincentive for placing connections on the list. The amendments would require that connections placed on the non-repairable list are at a ratio of one connection per two valves. The fraction of components allowed on the list is strictly limited to the number of valves and valves only located at the refinery. This would mean if a refinery has 50,000 valves and the fraction of valves allowed on the non-repairable list is 0.2 percent, then the number of valves allowed on the list could not exceed 100. Each connection on the list, two spaces of the 100 allotted for valves would no longer be available for valves. In addition to this allowance, the 10,000 ppm limit provisions would also apply to connections.

IV. OTHER ISSUES

Other strategies were identified that had the potential for achieving emission reductions. Staff examined definitions for complex equipment, such as heat exchangers, that are currently regulated pursuant to Section 8-18-301. Staff also reviewed the development of procedures to address leaks from these complex components, such that the facility would not have to utilize the variance process

[4] South Coast AQMD, Rule 1173, §(g)(2); Ventura County APCD. Rule 74-7, §§E.5 and E.7; and San Joaquin Valley Unified APCD, Rule 4451 §§5.3.1 and 5.3.2 and Rule 4452 §5.2.1.2.

when these leaks occur, as is currently the case. However, due to time constraints, staff was unable to fully explore and develop these strategies. These issues and strategies are being documented for future rule making efforts.

Violations for Leaks Detected During District Inspections

The rule currently allows refineries 24 hours to repair leaks found by District inspectors. Leaks discovered by refinery personnel must be repaired within seven days. One possibility, in which leaks detected by District staff and found to be in excess of a minimum percentage of the components inspected could be determined to be a violation. This would place all the responsibility on the refinery. The District inspections would not substitute for operator inspections. The expectation is that if operator inspections were performed sufficiently, there would be little opportunity for District staff to discover any unidentified leaks. The facility concern was that even if they had a good LDAR program, leaks could still occur and issuing a violation would be a disincentive to perform.

Accelerated Replacement of Equipment with Frequent Leaks/Repairs

Some specific equipment components appear to be more prone to leaks and require more repair. Equipment such as this should be replaced at an accelerated rate with equipment that meets the BACT requirements. The accelerated rate should reflect the leak/repair history of the equipment. If equipment components were given a maximum number of allowable leaks/repairs within a specific timeframe, the components demonstrated to leak frequently would be addressed more quickly. Other equipment with a history of no leaks could be inspected less frequently, as is currently allowed by the Rule. Other California air districts have similar provisions in their fugitive emissions rules.[5]

Replacement of Inaccessible Equipment with Superior Technologies

Replacement of inaccessible equipment with superior technologies should reduce the potential for emissions. Inaccessible equipment is defined as any equipment located 13 feet above the ground when access is required from the ground or equipment located over 6.5 feet from a platform when access is required from a platform. Under the current regulation these components are inspected for leaks once a year rather than quarterly, as required for accessible components. This reduced inspection frequency results in a longer average time period before a leak is detected and repaired.

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[5] South Coast AQMD Rule 1173, §(g)(2) and Ventura County APCD Rule 74-7, §§E.5 and E.7.

Control Emissions from Heat Exchangers

Additional sources of VOC emissions are heat exchangers. Heat exchangers can leak VOCs into the liquid cooling medium and be emitted from the cooling towers of refineries. These emissions should be addressed. A basic first step would be to measure VOC emissions at cooling towers over an entire cycle to determine whether emissions are significant. To determine if a leak exists in a heat exchanger, the VOC concentrations of cooling water at the inlet and outlet to the heat exchanger could be compared. A higher VOC concentration at the outlet would indicate a leak. Measurements could be made with probes placed in the inlet and outlet streams or by the placement of tap valves to collect samples from each stream. A standard could then be established either at the cooling tower or at each heat exchanger.

Quantification of Mass Emissions and Emission Caps

If mass emissions could be reliably determined, mass emissions from equipment placed on the non-repairable equipment list could be offset by other equipment to which Reg 8-18 is applicable. This approach could result in a maximum limit, or cap, on the amount of fugitive emissions. Any leaking equipment found to have a mass emissions rate that results in the total fugitive emission rate being exceeded, could be required to offset the emissions from equipment already on the non-repairable list. This approach provides several benefits. It provides an approximation of the fugitive emissions for a facility for every piece of equipment on the non-repairable list and also provides an incentive to replace the high-emitting equipment as soon as possible. This is more advantageous than allowing equipment to remain on the non-repairable list up to five years irrespective of the emission rate. This approach gives the facility flexibility to make the most cost effective choice that results in the least emission consequences.

Increase Inspection Frequencies

Increasing the frequency of inspections would reduce the total time period between emissions testing and reduce the time that a leaking component goes undetected, and decrease emissions.

Smart LDAR

The U.S. EPA and API have jointly worked on a project called “Smart LDAR” through the U.S.EPA’s Common Sense Initiative – Petroleum Refining Sector. The project has attempted to determine whether there are means to focus efforts on those components that contribute most significantly to total fugitive emissions. Research indicates that a small subset of all leaking components is responsible for most of the emissions. Rather than focus effort on controlling minor leaks, the

Smart LDAR project is examining the use of remote sensing methods that would allow quick identification and repair of leaks causing large emissions.

V. ISSUES FOR CLARIFICATION

There are several clarifying issues that were not addressed in this rulemaking process. These issues should be addressed in the future.

Combine PRDs/PRVs Requirements in a Single Rule

Staff will address emission reductions for pressure relief devices (PRDs) and pressure relief valves (PRVs) in a separate rulemaking process for Regulation 8, Rule 28, Episodic Releases From Pressure Relief Devices at Petroleum Refineries and Chemical Plants (Reg 8-28). The provisions relating to PRDs/PRVs in Reg 8-18 should be deleted and addressed in Reg 8-28.

Clarify the Application of EPA Method 21 and the Definition of Connections

Rule 8-18 specifies the use of U.S. EPA Method 21 for leak detection and quantification. Method 21 specifies the manner in which equipment components should be inspected for leaks, but does not define the components themselves. To clarify any potential misunderstanding, all static connecting components of equipment (unless otherwise stated) should be considered connections. Dynamic components with moving parts should be treated as valves, pumps, or compressors. The static components of valves, pumps, compressors, and pressure relief devices should be clearly defined as connections and, as such, would only be eligible for placement on a non-repairable list for delayed repair or replacement at the ratio of one connection for every two valves.

Clarify Inspection Frequency for Connections

Rule 8-18 does not require inspections for connections. It should be clarified to explicitly state that inspections are optional. If the facility has no connector inspection program, then a leak found by the District is an immediate violation.

VI. EMISSIONS INVENTORY AND EMISSIONS REDUCTIONS

Emission Inventory

Emission inventory data collected over the past several years indicate that fugitive emissions have been constantly decreasing. Table 3 details these reductions. There was a significant emissions reduction between the 2001 inventory and the current modified 2002 inventory. This emission reduction is due mostly to the adoption of new correlations factors from the EPA that are published in the ARB's "California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities."

However, not withstanding the change in correlation factors, there has been a general downward trend to fugitive emissions over the last several years. This trend is largely due to improvement in the leak detection and repair programs, which became more effective over time.

TABLE 3
Estimated Emissions Inventories for Fugitives

Description	**SIP (Modified 1999 Inventory)[1]**	**2000 Inventory[1]**	**2001 Inventory[1]**	**Current (Modified 2002 Inventory) [1,2,3]**
Refinery	**(organic emissions - pounds/day)**			
Chevron	7 ,821	7,821	7,773	2,294
Shell	352	352	351	381
ConocoPhillips	1,543	1,543	1,473	1,474
Valero Asphalt	35	35	35	22
Valero	1,969	530	257	332
Tesoro	1,690	1,690	1,688	128
TOTAL (tons/day)	**6.71**	**5.99**	**5.79**	**2.32**

1. The annual emission inventories are based on emission estimates provided to the District by each refinery.
2. The values in this column reflect the use of modified correlation factors for each component category, as published in the ARB's "California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities."
3. These values are currently under review and may not reflect the final emission inventory for 2002.

Emission Reductions

The emission reductions for the proposed amendments are presented in Table 4. These emission reductions are based on the assumption that all leaking components other than connection will be discovered at the five Bay Area refineries.

TABLE 4
Emission Reduction Estimates[1].

	Rule 8-18 Emissions[2] (lbs/day (TPD))	Amended Rule 8-18 Emissions[3] (lbs/day (TPD))	Emission Reductions (tons/day (TPD))
Valves	605 (0.30)	248 (0.12)	357 (0.18)

1. Assumes a total of 200,000 valves at all five Bay Area refineries.
2. Assumes that the total number of valves leaking is 0.50 percent of all valves.
3. Assumes that the total number of valves leaking is 0.20 percent of all valves.

VII. CONTROL COST EFFECTIVENESS

(TO BE INSERTED)

Appendix A

Comparison of the Basic Provisions of the Fugitive Emissions Rules of Four California Air Districts

Comparison of the Basic Provisions of the Fugitive Emissions Rules of Four California Air Districts

	BAAQMD Rule 8-18	South Coast AQMD Rule 1173	SJVUAPCD Rules 4451 & 4452	Ventura Co. APCD Rule 74.7
Minimum Leak Limits	§§8-18-211, 301→305	§1173 (d)(1)	§4451.3.9.1.1; §4451.3.9.2; §4452.3.6.1	§§74-7 L.18→L.20, L.22 & L.23,
Liquid	3 drops/min	3 drops/min	3 drops/min	minor ≥3 drops/min major = stream or mist
Valves	100 ppm	HL > 500; LL > 50k/10k*	10,000 ppm	minor ≥1,000 1,000 > major ≥ 10k
Connections	100 ppm	HL > 500; LL > 50k/10k*	10,000 ppm	
Pumps/ Compressors	500 ppm	HL > 500/100*; LL > 50k/10k*	10,000 ppm	
PRDs/PRVs	500 ppm	LL > 50k/200*	10,000 ppm	major > 200 ppm
		L = leak (in ppm or drops/min) HL = heavy liquid leak LL = light liquid/gas/vapor leak *Limits for leaks found above leak thresholds (see Turnaround Lists)		
Inspection Frequencies	§§8-18-401.1→401.3	§§1173 (f)(1)(B) & (C)	§4451.5.2 & §4452.5.1	§74-7 D.1 & D.2
Valves	Quarterly	Quarterly	Quarterly	Monthly →Quarterly
Connections	Annually	Quarterly	Annually	Monthly →Annually
Pumps/ Compressors	Quarterly	Quarterly	Quarterly	Monthly →Quarterly
PRDs/PRVs	Annually	Quarterly	Quarterly	Quarterly (≤110 days)
Inaccessibles	Annually	Annually	Annual or shutdowns	
Non-Repairable List	§§8-18-306.2 & 306.3	Leak Thresholds: §1173(d)(1)Table 1	§4451.5.2 & §4452.5.1.4	
Duration	≤ 5 yrs.	No time limit (∞)	Next shutdown	none
Valves	0.5% 1%	0.5%	2%	none
Connections	0% 0%	0.5%	2%	none

	BAAQMD Rule 8-18		South Coast AQMD Rule 1173	SJVUAPCD Rules 4451 & 4452	Ventura Co. APCD Rule 74.7
Pumps/ Compressors	1%	5%	1%	2% Shutdown or one year	none
PRDs/PRVs	1%	5%	1%	2%	
Repair Schedules	§§8-18-301→305		§1173 (g)(1) Table 2	§4451.5.3.2 & §4452.5.1.4	§74-7 E Table 1
Valves	24 hr (District)/ 7 days (operator)		500 < LL ≤ 10k: 7 days 100 < HL< 500: 7 days 3 drops/min & 100 < HL ≤ 500: 7 days 10k < L ≤ 25k: 2 days/ext 3 days L > 25k: 1 day HL > 500: 1 day/ext 3 days LL > 3 drops/min: I day	m: 1 yr M: 15 days reduce < 10 d/min / 10k or vent to flare or control or show control is infeasible	m: 14 days, M: 5 days, S: 1 days
Connections	24 hr (District)/ 7 days (operator)			m: 1 yr M: 15 days reduce < 10 d/min / 10k or vent to flare or control or show control is infeasible	m: 14 days, M: 5 days, S: 1 days
Pumps/ Compressors	24 hr (District)/ 7 days (operator)			15 day > 15 day: replace, vent to control or repair at shutdown	m: 14 days, M: 5 days, S: 1 days
PRDs/PRVs	7 days (District)/ 17 days (operator)		200 < L ≤ 25k: 2 days	m: 1 yr M: 15 days reduce < 10 d/min / 10k or vent to flare or control or show control is infeasible	m: 14 days, M: 5 days, S: 1 days
			L = leak (in ppm or drops) HL = heavy liquid leak LL = light liquid/gas/vapor leak ext = extended repair period	Leak: m≤ 10 drops/min or 10,000 ppm M > 9 drops/min or 10,000 ppm.	Leaks: m≤ 10,000, 10,000 <M ≤ 25,000 S >25,000